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Description

This invention relates to radiation apparatus.

More especially the invention relates to the radiography art and finds particular application in conjunction with computerized tomographic (CT) scanners and will be described with particular reference thereto. However, it is to be appreciated that the present invention may also find application in conjunction with other radiation apparatus, i.e. radiation treatment apparatus, and other imaging apparatus.

Heretofore, tomographic scanners have commonly included a floor-mounted frame assembly which remains stationary during a scan. An x-ray tube is mounted to a rotatable frame assembly which rotates around a patient receiving examination region during the scan. Radiation from the x-ray tube traverses the patient receiving region and impinges upon an array of radiation detectors. From the radiation data sampled by the detectors and the position of the x-ray tube during each sampling, a tomographic image of one or more slices through the patient is reconstructed.

An x-ray tube generates x-rays by directing a high energy electron beam against a tungsten target. One of the persistent problems in CT scanners and other radiographic apparatus is dissipating the waste heat created while generating x-rays. In higher powered x-ray tubes, the anode turns so that the high energy electron beam only dwells a fraction of a second at a time on any point on the anode. The x-ray tube is jacketed with a lead lined housing. A cooling oil is circulated between the glass envelope of the x-ray tube and the housing to remove additional heat.

In some scanners, the x-ray tube rotates in one direction during a scan and returns in the other direction for the next scan. Such scanners are normally limited to about 360° of rotation. The single rotation enables the hot cooling oil to be conveyed from the rotating frame by flexible hoses to a non-rotating heat exchanger. Accommodating the cooling oil-carrying hoses is a space consumptive handling problem. The heat exchanger is commonly a radiator disposed within the CT scanner housing that is cooled by fans which blow room air through the heat exchanger and back into the room. This places an extra load on the room air conditioning system.

In other CT scanners, the cooling oil is circulated to a radiator or other air-oil heat exchanger that is mounted on the rotating frame portion. This alleviates the hose handling problems and enables the x-ray tube to rotate a plurality of times, e.g. a continuous rotate scanner. However, accommodating the size and weight of the heat exchanger in the tight space constraints of the rotating frame is difficult. As the x-ray tube and rotating frame portion rotate, air passes through the heat exchanger cooling the oil. The heated air that is discharged into the room that contains the CT scanner again places a greater load on the room air conditioning system.

One of the limiting factors on the speed of a CT scan is the amount of x-rays produced by the x-ray tube. The tube must irradiate each detector for a sufficient duration that each detector receives the minimum total flux needed to reconstruct a good contrast image. Lower power tubes require the tube to dwell or focus longer on each detector. Larger, more powerful x-ray tubes supply the minimum flux more quickly, allowing the speed of rotation to be increased, hence the scan time decreased. However, as the x-ray tubes become more powerful, more heat is generated. More heat is also generated in continuous rotate scanners in which the tube remains "on" during several consecutive rotations for multislice imaging.

Larger x-ray tubes, such as 0.178 metre (seven inch) anode x-ray tubes, generate so much heat that the prior art heat dissipation techniques are taxed. The limited air volume in the interior of a CT scanner limits the effectiveness of the rotating oil-air heat exchanger. Space constraints prevent larger heat exchangers from being accommodated on the rotating frame. Moreover, the added heat taxes the cooling capacity of room air conditioning systems to the point that room cooling capacity must be increased.

According to the present invention there is provided a radiation apparatus comprising a radiation source mounted on a frame for rotation relative to a stationary frame charaterised by a fluidic slip ring for providing a cooling fluid communication between the rotatable frame and the stationary frame and a cooling fluid calculating means for circulating a cooling fluid through the fluidic slip ring from the rotatable frame to the stationary frame and vice-versa.

One advantage of the present invention is that it enables the effective cooling of a radiation source.

Another advantage of the present invention is that it enables heat from the radiation source to be dissipated externally of the apparatus and the apparatus control room.

Another advantage of the present invention is that it facilitates the use of high power radiation sources.

Another advantage of the present invention is that it enables the x-ray tube of a CT scanner to rotate continuously.

EP-A-0225964 discloses a cooling system for relatively movable components, such as a rotor seated for rotation with respect to a stationary

component, including a sealed channel in the stationary component disposed between the stationary component and the movable component, and an evaporator disposed within the sealed channel. The channel is filled with coolant, such as alcohol or oil, which is circulated by a pump in a closed circulation path. Heat is thereby conveyed from the system components to be cooled to the evaporator, and from the evaporator to a location where the heat can be dissipated without disturbing operation of the device. The cooling system is suitable for use, for example, in a computer tomograph for cooling the radiation detector.

One radiation apparatus in accordance with the present invention will now be described, by way of example, with reference to the accompanying drawings in which:-

Figure 1 is a diagrammatic illustration of the apparatus;

Figure 2 is a perspective view in partial section of a fluidic slip ring and associated hardware of the apparatus, the associated hardware including a drive motor for rotating an x-ray tube supporting rotating frame of the apparatus;

Figure 3 is a more detailed illustration of the fluidic slip ring of Figure 2 in partial section; and

Figures 4A, 4B and 4C are illustrative of a coolant inlet, a coolant return, and leakage fluid interconnections, respectively, of the fluidic slip ring of Figure 2.

Referring to Figure 1, the apparatus comprises a CT scanner which includes a floor-mounted or stationary frame portion A whose position remains fixed during data collection. An x-ray tube B is rotatably mounted by a bearing and fluidic slip ring assembly C for continuous rotation. The fluidic slip ring passes a cooling fluid, such as oil, water, sulphur, hexafluoride, and other liquids and gases, between an externally mounted chilling unit or heat exchanger D and the rotatably mounted x-ray tube B.

The stationary frame portion A includes a cylinder 10 that defines a patient receiving examination region 12 therein. An array of radiation detectors 14 are disposed concentrically around the patient receiving region. The stationary frame with the rotating frame can be canted or tipped to scan slices at selectable angles. A control console 16 contains an image reconstructing means 18 for reconstructing an image representation of output signals from the detector array 14. A video monitor 20 converts the reconstructed image representation into a man-readable display. The console also includes appropriate tape and disk recording means for archiving image representations, performing image enhancements, and the like. Various control functions, such as initiating a scan, selecting among different types of scans, calibrating the system, and the like are also performed at the control panel.

With continuing reference to FIGURE 1 and further reference to FIGURE 2, the x-ray tube B is enclosed in an oil-filled housing 30 that has an x-ray permeable window directed toward the patient receiving region 12. Inside the housing, a motor rotates an anode, such as a seven inch anode, in the plane of the patient receiving region and the x-ray transmissive window. An oil pump circulates the oil from the housing through a heat exchanger 32. The heat exchanger transfers heat from the oil to a liquid coolant.

An electron beam emitted by a cathode strikes the rotating anode adjacent the window such that x-rays are emitted through the window. Appropriate x-ray collimators focus the radiation into one or more planar beams, or the like, as are conventional in the art. A shutter under control from the console selectively gates the beam on and off to control patient dosage. Electrical power from the console is conveyed to an electrical slip ring 34 that is mounted in association with the bearing and fluidic slip ring assembly C. A high voltage power supply is mounted for rotation in association with the x-ray tube for converting the lower voltage conveyed across the electrical slip ring to the appropriate high voltages for operating the x-ray tube.

With particular reference to FIGURE 2, the x-ray tube B is mounted on a rotating x-ray tube support or frame 40. The rotating frame assembly includes an annular ring portion 42 which is connected with a rotating race 44 of a large bearing that surrounds the patient receiving region. The bearing also includes a stationary race 46 that is mounted to an annular tubular structure of the stationary frame assembly A. The bearing also includes a plurality of balls or rollers 48 for providing smooth rolling interaction between the rotating and stationary races. A motor 50 rotates the x-ray tube and rotatable frame relative to the stationary frame. The motor includes a plurality of permanent magnets 52 that are mounted on a lower surface of the rotating race 44 for rotation therewith. An annular motor lamination 54 and surrounding windings 56 create electrical fields which drive the magnets 52 and are mounted to the patient receiving tube 10 which is also mounted to the stationary frame assembly. Interaction of the winding and permanent magnetic fields rotates the rotatable frame assembly relative to the stationary frame.

With reference to FIGURE 3, a fluidic slip ring 60 is connected with the stationary and rotating frame portions. The fluidic slip ring includes an outer, stationary annular portion 62 that is mounted to the annular tubular structure and the patient receiving sleeve 10. In the illustrated embodiment, the stationary annular portion has a smooth, flat

inner surface. The fluidic slip ring also includes a rotatable annular portion 64 which is connected with the rotating bearing race 44 and the rotating frame portion 40. The rotating annular portion 64 includes a plurality of channels or grooves, including an incoming cooling fluid channel 66 and an outgoing cooling fluid channel 68. A series of seal receiving grooves or channels 70 are disposed between and to either side of the fluid carrying channels 66, 68. Gaskets or seals 72 are carried in each groove to isolate the incoming and outgoing cooling fluid and to prevent leakage. A pair of leakage channels 74 are disposed outward from the outermost seals to retrieve any fluid that might leak past the fluid seals. A pair of final leakage seals 76 are disposed outward from the leakage channels to retain any leaking coolant.

With particular reference to FIGURES 4A, 4B, and 4C, the stationary annular portion 62 has three fluid paths bored therethrough. A first fluid path 80 extends from an inlet connector or coupling 82 to an aperture or port 84 that is in axial alignment with the inlet or chilled cooling fluid channel 66. An outlet passage 86 is defined in fluid communication between an outlet coupling or fitting 88 and an aperture or port 90 that is disposed in longitudinal alignment with the outgoing or hot cooling fluid channel 68. A drain fitting 92 is connected with a leakage fluid passage 94 that has apertures or ports 96, 98 in alignment with the leakage collecting channels 76.

The rotating frame has a chilled fluid path 100 extending from the chilled fluid channel 66 to the heat exchanger 32. Heated fluid is returned from the heat exchanger 32 through path 102 to the hot cooling fluid channel 68.

With reference again to FIGURE 1, a circulating means, such as a pump 110, pumps cooled cooling fluid from the chiller D to the inlet channel 66, through the heat exchanger 32 to cool the x-ray tube oil and through the return channel 68 into a reservoir 112. Cooling fluid is drawn from the reservoir, through the chiller and returned by the pump 110 through the fluidic slip ring. The chiller includes a compressor and freon-type refrigerant system for efficiently cooling the cooling fluid. Preferably, the chiller has an air-fluid heat exchanger that discharges heat at the exterior of the building in which the CT scanner is located. Optionally, the oil-coolant heat exchanger 32 may be eliminated and the x-ray tube oil circulated to the chiller.

Claims

1. A radiation apparatus comprising a radiation source (B) mounted on a frame (40) for rotation relative to a stationary frame characterised by a fluidic slip ring (60) for providing a cooling fluid communication between the rotatable frame (40) and the stationary frame and a cooling fluid circulating means (110) for circulating a cooling fluid through the fluidic slip ring (60) from the rotatable frame (40) to the stationary frame and vice-versa.

2. An apparatus according to Claim 1, wherein said fluid circulating means (110) circulates the cooling fluid between the rotatable frame (40) and a cooling means (D) arranged on the stationary frame for cooling said cooling fluid.

3. An apparatus according to Claim 1 or Claim 2, wherein said radiation source (B) is oil cooled and said apparatus further includes a heat exchanger (32) for transferring heat from the radiation source cooling oil to the cooling fluid, said heat exchanger (32) being mounted on the rotatable frame (40) for rotation with the radiation source (B).

4. An apparatus according to any one of Claims 1 to 3, wherein the fluidic slip ring (60) includes a stationary annular portion (62) and a mating rotating annular portion (64), one (64) of the stationary (62) and rotating (64) annular portions having at least two circumferential cooling fluid carrying channels (66, 68) therein, which channels (66, 68) cooperate with the other said annular portion (62) for the carrying of cooling fluid.

5. An apparatus according to Claim 4, wherein there are two said circumferential cooling fluid carrying channels (66, 68) and said apparatus further includes a first annular seal (72) disposed between the two fluid carrying channels (66, 68) and two further annular seals (72) disposed respectively outward of the two channels, such that the seals (72) inhibit fluid from leaving the two fluid carrying channels (66, 68) and from intermixing between the two fluid carrying channels (66, 68).

6. An apparatus according to Claim 5, further including a pair of circumferential drain channels (74) disposed in one of the annular portions (62, 64) respectively outward of the further seals for receiving cooling fluid that has leaked through the further seals (72) and a pair of additional annular seals (76) disposed respectively outward of the drain channels.

7. An apparatus according to Claim 6, wherein the stationary annular portion (62) has a drain passage (94) therethrough and drain ports (96, 98) are in fluid communication with each of the

drain channels (74).

8. An apparatus according to any one of Claims 4 to 7, wherein the fluid carrying channels (66, 68) are defined in the rotating annular portion (64) and wherein the rotating annular portion (64) includes at least two fluid passages (100, 102) therethrough for carrying cooling fluid to components on the rotatable frame (40).

9. An apparatus according to any one of Claims 4 to 7, wherein the stationary annular portion (62) has a smooth interior surface that is engaged by the annular seals (72, 76).

10. An apparatus according to any one of Claims 4 to 9, further including at least two fluid passages (80, 86) through the stationary annular portion (62) extending between inlet and outlet cooling fluid fittings (82, 88) and apertures (84, 90) disposed in alignment with the fluid carrying channels (66, 68).

11. An apparatus according to any one of Claims 1 to 3 for use as a computerized tomography scanner, wherein said radiation source (B) comprises an x-ray tube (B) which is mounted on said rotatable frame (40) for rotation about a patient receiving region (12) defined by the stationary frame of the apparatus and which has an x-ray window through which x-rays are transmitted across the patient receiving region (12); and the apparatus further includes an x-ray detection means (14) for detecting x-rays which have traversed the patient receiving region (12) and an image reconstruction means (18) for reconstructing an image representation from signals generated by the x-ray detection means (14).

12. An apparatus according to Claim 11, wherein the fluidic slip ring (60) includes: a rotatable annular portion (64) having first (66) and second (68) circumferential cooling fluid channels defined therein; a stationary annular portion (62) surrounding the rotatable annular portion (64) in a generally mating relationship with the channels (66, 68); a sealing means (72) for preventing cooling fluid flow out of the channels (66, 68) between the rotatable (64) and stationary (62) annular portions; a first fluid passage (80) through the stationary annular portion (62) with a first aperture (84) in alignment with the first channel (66) and a second passage (86) through the stationary annular portion (62) having an aperture (90) in alignment with the second channel (68), the stationary annular portion passages (80, 86) being operatively connected with the fluid circulating means (110), whereby cooling fluid flows through the first passage (80) into the first channel (66), flows from the first channel (66) to the rotating frame (40), absorbs x-ray tube heat, flows from the rotating frame (40) back to the second channel (68), and flows through the second passage (86) of the stationary annular portion (62).

13. An apparatus according to Claim 12, further including a mechanical chiller (D) which is stationarily mounted in fluid communication with the stationary annular portion passages (80, 86) for cooling the cooling fluid.

14. An apparatus according to Claim 12 or 13, wherein the rotatable annular portion (64) further includes a pair of leakage channels (74) disposed respectively outward of the first and second cooling fluid (66, 68) channels for receiving cooling fluid which has leaked through the sealing means (72); a leakage sealing means (76) is disposed outward of the leakage channels (74) for holding leakage fluid in the leakage channels (74); a third passage (94) is defined through the stationary annular portion (62) and has apertures (96, 98) in alignment with each of the leakage channels (74) for draining cooling fluid therefrom.

15. An apparatus according to Claim 11, wherein the fluidic slip ring (60) includes: a stationary annular portion (62) and a rotating annular portion (64), one (64) of the stationary (62) and rotating (64) annular portions having a series of channels (66, 68) therein, which channels (66, 68) interact with the other annular portion (62) to define at least two fluid carrying paths therebetween.

16. An apparatus according to Claim 15, further including a first annular seal (72) disposed between the two channels (66, 68) and two further annular seals (72) disposed respectively outward of the two channels (66, 68), such that the seals (72) inhibit fluid from leaving the two channels (66, 68) and from intermixing between the two channels (66, 68).

17. An apparatus according to Claim 16, further including annular drain channels (74) disposed in at least one (64) of the annular portions (62, 64) outward of the first and second channels (66, 68) for receiving cooling fluid that has leaked through said seals (72) and additional sealing means (76) disposed outward of the drain channels (74).

18. An apparatus according to Claim 17 wherein the stationary annular portion (62) has a smooth interior surface that is engaged by the annular seals (72) and the sealing means (76).

Patentansprüche

1. Strahlungsgerät, aufweisend eine Strahlenquelle (B), die an einem relativ zu einem stationären Rahmen drehbaren Rahmen (40) angebracht ist,
gekennzeichnet durch
einen Fluid-Gleitring (60), der eine Kühlfluidkommunikation zwischen dem drehbaren Rahmen (40) und dem stationären Rahmen vorsieht, und durch eine Kühlfluidzirkulationseinrichtung (110), die ein Kühlfluid durch den Fluid-Gleitring (60) vom drehbaren Rahmen (40) zum stationären Rahmen (40) und umgekehrt zirkuliert.

2. Gerät nach Anspruch 1, in welchem die Fluidzirkulationseinrichtung (110) das Kühlfluid zwischen dem drehbaren Rahmen (40) und einer Kühleinrichtung (D) zirkuliert, die am stationären Rahmen zum Kühlen des Kühlfluids angeordnet ist.

3. Gerät nach Anspruch 1 oder 2, in welchem die Strahlenquelle (B) ölgekühlt ist und das Gerät ferner einen Wärmeaustauscher (32) zur Übertragung von Wärme vom Strahlenquellen-Kühlöl auf das Kühlfluid umfaßt, wobei der Wärmeaustauscher (32) am drehbaren Rahmen (40) zur Drehung mit der Strahlenquelle (B) angebracht ist.

4. Gerät nach einem der Ansprüche 1 bis 3, in welchem der Fluid-Gleitring (60) einen stationären ringförmigen Abschnitt (62) und einen passenden rotierenden ringförmigen Abschnitt (64) aufweist, wobei einer (64) des stationären (62) und rotierenden (64) ringförmigen Abschnitts zumindest zwei Kühlfluid führende Umfangs-Kanäle (66, 68) in sich aufweist, wobei diese Kanäle (66, 68) mit dem anderen solchen ringförmigen Abschnitt (62) zur Beförderung von Kühlfluid zusammenwirken.

5. Gerät nach Anspruch 4, in welchem zwei solche Kühlfluid führenden Umfangs-Kanäle (66, 68) vorgesehen sind und das Gerät ferner eine erste ringförmige Dichtung (72), die zwischen den beiden Fluid führenden Kanälen (66, 68) liegt, und zwei weitere ringförmige Dichtungen (72) aufweist, die jeweils auswärts der beiden Kanäle angeordnet sind, derart, daß die Dichtungen (72) verhindern, daß Fluid die beiden Fluid führenden Kanäle (66, 68) verläßt und zwischen den beiden Fluid führenden Kanälen (66, 68) vermischt.

6. Gerät nach Anspruch 5, ferner aufweisend ein Paar Umfangs-Abzugskanäle (74), die in einem der ringförmigen Abschnitte (62, 64) jeweils auswärts der weiteren Dichtungen zur Aufnahme von Kühlfluid angeordnet sind, das durch die weiteren Dichtungen (72) geleckt ist, und ein Paar zusätzlicher ringförmiger Dichtungen (76), die jeweils auswärts der Abzugskanäle angeordnet sind.

7. Gerät nach Anspruch 6, in welchem der stationäre ringförmige Abschnitt (62) eine sich durch ihn erstreckende Abzugspassage (94) aufweist und Abzugsöffnungen (96, 98) in Fluidkommunikation mit jedem der Abzugskanäle (74) stehen.

8. Gerät nach einem der Ansprüche 4 bis 7, in welchem die Fluid führenden Kanäle (66, 68) im rotierenden ringförmigen Abschnitt (64) definiert sind und in welchem der rotierende ringförmige Abschnitt (64) zumindest zwei sich durch ihn erstreckende Fluidpassagen (100, 102) zum Transportieren von Kühlfluid zu Komponenten am rotierbaren Rahmen (40) aufweist.

9. Gerät nach einem der Ansprüche 4 bis 7, in welchem der stationäre ringförmige Abschnitt (62) eine glatte Innenfläche aufweist, an die die ringförmigen Dichtungen (72, 76) angreifen.

10. Gerät nach einem der Ansprüche 4 bis 9, ferner aufweisend zumindest zwei Fluidpassagen (80, 86) durch den stationären ringförmigen Abschnitt (62), die sich zwischen Einlaß- und Auslaßkühlfluidanschlußteilen (82, 88) und Öffnungen (84, 90) erstrecken, die ausgerichtet mit den Fluid führenden Kanälen (66, 68) vorgesehen sind.

11. Gerät nach einem der Ansprüche 1 bis 3 zur Verwendung als Computertomographie-Scanner, in welchem die Strahlenquelle (B) eine Röntgenröhre (B) umfaßt, die am rotierbaren Rahmen (40) zur Drehung um eine durch den stationären Rahmen des Geräts definierte Patientenaufnahmeregion (12) angebracht ist und ein Röntgenstrahlfenser aufweist, durch das Röntgenstrahlen durch die Patientenaufnahmeregion (12) hindurchgelassen werden; und in welchem das Gerät ferner eine Röntgenstrahldetektoreinrichtung (14) zum Detektieren von Röntgenstrahlen umfaßt, die die Patientenauf-

nahmeregion (12) durchquert haben, und eine Bildrekonstruktionseinrichtung (18) zur Rekonstruktion einer Bilddarstellung aus von der Röntgenstrahldetektoreinrichtung (14) erzeugten Signalen.

12. Gerät nach Anspruch 11, in welchem der Fluid-Gleitring (60) umfaßt: einen drehbaren ringförmigen Abschnitt (64), der einen ersten (66) und zweiten (68) Kühlfluidumfangs-Kanal aufweist, die in ihm definiert sind; einen stationären ringförmigen Abschnitt (62), der den drehbaren ringförmigen Abschnitt (64) in einer im wesentlichen angepaßten Beziehung bezüglich der Kanäle (66, 68) umgibt; eine Abdichteinrichtung (72), die das Ausfließen von Kühlfluid aus den Kanälen (66, 68) zwischen dem drehbaren (64) und stationären (62) ringförmigen Abschnitt verhindert; eine erste Fluidpassage (80) durch den stationären ringförmigen Abschnitt (62) mit einer ersten Öffnung (84) in Ausrichtung mit dem ersten Kanal (66) und einer zweiten Passage (86) durch den stationären ringförmigen Abschnitt (62), der eine Öffnung (90) in Ausrichtung mit dem zweiten Kanal (68) aufweist, wobei die Passagen (80, 86) des stationären ringförmigen Abschnitts funktionswirksam mit der Fluidzirkulationseinrichtung (110) verbunden sind, wodurch Kühlfluid durch die erste Passage (80) in den ersten Kanal (66) strömt, vom ersten Kanal (66) zum rotierenden Rahmen (40) strömt, Röntgenröhrenwärme absorbiert, vom rotierenden Rahmen (40) zurück zum zweiten Kanal (68) strömt und durch die zweite Passage (86) des stationären ringförmigen Abschnitts (62) strömt.

13. Gerät nach Anspruch 12, ferner aufweisend einen mechanischen Kühler (D), der stationär in Fluidkommunikation mit den Passagen (80, 86) des stationären ringförmigen Abschnitts zum Kühlen des Kühlfluids angebracht ist.

14. Gerät nach Anspruch 12 oder 13, in welchem der drehbare ringförmige Abschnitt (64) ein Paar Leckkanäle (74) umfaßt, die jeweils auswärts des ersten bzw. zweiten Kühlfluid (66, 68)-Kanals zur Aufnahme von Kühlfluid angeordnet sind, das durch die Dichtungseinrichtung (72) geleckt ist; eine Leckabdichteinrichtung (76) auswärts der Leckkanäle (74) zum Halten von Leckfluid in den Leckkanälen (74) angeordnet ist; eine dritte Passage (94) durch den stationären ringförmigen Abschnitt (62) definiert ist und Öffnungen (96, 98) ausgerichtet zu jedem der Leckkanäle (74) zum Abziehen von Kühlfluid hieraus aufweist.

15. Gerät nach Anspruch 11, in welchem der Fluid-Gleitring (60) umfaßt: einen stationären ringförmigen Abschnitt (62) und einen rotierenden ringförmigen Abschnitt (64), wobei einer (64) des stationären (62) und rotierenden (64) ringförmigen Abschnitts eine Serie von Kanälen (66, 68) in sich aufweist, wobei die Kanäle (66, 68) mit dem anderen ringförmigen Abschnitt (62) zur Definition zumindest zweier Fluid führender Pfade dazwischen zusammenwirken.

16. Gerät nach Anspruch 15, ferner aufweisend eine erste ringförmige Dichtung (72), die zwischen den beiden Kanälen (66, 68) angeordnet ist, und zwei weitere ringförmige Dichtungen (72), die jeweils auswärts der beiden Kanäle (66, 68) angeordnet sind, derart, daß die Dichtungen (72) verhindern, daß Fluid aus den beiden Kanälen (66, 68) austritt und sich zwischen den beiden Kanälen (66, 68) vermischt.

17. Gerät nach Anspruch 16, ferner aufweisend ringförmige Abzugskanäle (74), die in zumindest einem (64) der ringförmigen Abschnitte (62, 64) auswärts des ersten und zweiten Kanals (66, 68) zur Aufnahme von Kühlfluid angeordnet sind, das durch die Dichtungen (72) geleckt ist, und eine zusätzliche Dichtungseinrichtung (76), die auswärts der Abzugskanäle (74) angeordnet ist.

18. Gerät nach Anspruch 17, in welchem der stationäre ringförmige Abschnitt (72) eine glatte Innenseite aufweist, an die die ringförmigen Dichtungen (72) und die Dichtungseinrichtung (76) angreifen.

Revendications

1. Appareil d'irradiation comprenant une source (B) d'un rayonnement monté sur un châssis (40) destiné à tourner par rapport à un châssis fixe, caractérisé par une bague collectrice fluidique (60) destinée à assurer la communication pour un fluide de refroidissement entre le châssis rotatif (40) et le châssis fixe, et un dispositif (110) de circulation d'un fluide de refroidissement par l'intermédiaire de la bague collectrice fluidique (60) du châssis rotatif (40) au châssis fixe, et inversement.

2. Appareil selon la revendication 1, dans lequel le dispositif (110) de circulation de fluide fait circuler le fluide de refroidissement entre le châssis rotatif (40) et un dispositif (D) de refroidissement placé sur le châssis fixe et destiné à refroidir le fluide.

3. Appareil selon la revendication 1 ou 2, dans lequel la source (B) du rayonnement est refroidie par une huile, et l'appareil comporte en outre un échangeur de chaleur (32) destiné à transférer de la chaleur de l'huile de refroidissement de la source de rayonnement au fluide de refroidissement, l'échangeur de chaleur (32) étant monté sur le châssis rotatif (40) afin qu'il tourne avec la source du rayonnement (B).

4. Appareil selon l'une quelconque des revendications 1 à 3, dans lequel la bague collectrice fluidique (60) comporte une partie annulaire fixe (62) et une partie annulaire rotative complémentaire (64), une première (64) des parties annulaires fixe (62) et rotative (64) ayant au moins deux canaux circonférentiels (66, 68) de circulation de fluide de refroidissement, les canaux (66, 68) coopérant avec l'autre partie annulaire (62) pour le transport du fluide de refroidissement.

5. Appareil selon la revendication 4, dans lequel deux canaux circonférentiels (66, 68) de circulation de fluide de refroidissement sont présents, et l'appareil comporte en outre un premier joint annulaire (72) d'étanchéité placé entre les deux canaux (66, 68) de circulation de fluide, et deux joints annulaires supplémentaires (72) d'étanchéité placés respectivement à l'extérieur des deux canaux, afin que les joints d'étanchéité (72) empêchent le fluide de quitter les deux canaux de circulation de fluide (66, 68) et de se mélanger entre les deux canaux (66, 68) de circulation de fluide.

6. Appareil selon la revendication 5, comprenant en outre deux canaux circonférentiels (74) d'évacuation placés dans l'une des parties annulaires (62, 64), à l'extérieur des joints supplémentaires d'étanchéité, et destinés à recevoir le fluide de refroidissement qui a fui par les joints supplémentaires d'étanchéité (72), et deux joints annulaires supplémentaires d'étanchéité (76) placés respectivement vers l'extérieur des canaux d'évacuation.

7. Appareil selon la revendication 6, dans lequel la partie annulaire fixe (62) a un passage d'évacuation (94) qui la traverse et des orifices (96, 98) d'évacuation communiquent avec chacun des canaux (74) d'évacuation.

8. Appareil selon l'une quelconque des revendications 4 à 7, dans lequel les canaux (66, 68) de circulation de fluide sont délimités dans la partie annulaire rotative (64), et la partie annulaire rotative (64) comporte au moins deux passages de fluide (100, 102) destinés à transmettre le fluide de refroidissement aux éléments placés sur le châssis rotatif (40).

9. Appareil selon l'une quelconque des revendications 4 à 7, dans lequel la partie annulaire fixe (62) a une surface interne lisse qui coopère avec les joints annulaires d'étanchéité (72, 76).

10. Appareil selon l'une quelconque des revendications 4 à 9, comprenant en outre au moins deux passages (80, 86) de fluide, formés dans la partie annulaire fixe (62) entre des embouts d'entrée et de sortie de fluide de refroidissement (82, 88), et des ouvertures (84, 90) placées dans l'alignement des canaux (66, 68) de circulation de fluide.

11. Appareil selon l'une quelconque des revendications 1 à 3, destiné à être utilisé comme tacographe, dans lequel la source du rayonnement (B) comprend un tube radiographique (B) monté sur le châssis fixe (40) afin qu'il tourne autour d'une région (12) destinée à contenir un patient, délimitée par le châssis fixe de l'appareil et qui a une fenêtre radiographique par laquelle des rayons X sont transmis à la région destinée à contenir un patient (12), et l'appareil comporte en outre un dispositif (14) de détection des rayons X qui ont traversé la région destinée à contenir un patient (12), et un dispositif (18) de reconstruction d'une représentation d'image à partir de signaux créés par le dispositif (14) de détection de rayons X.

12. Appareil selon la revendication 11, dans lequel la bague collectrice fluidique (60) comporte une partie annulaire rotative (64) ayant des premier (66) et second (68) canaux circonférentiels de fluide de refroidissement délimités dans cette partie, et une partie annulaire fixe (62) entourant la partie annulaire rotative (64) de manière que les canaux (66, 68) coopèrent de manière complémentaire de façon générale, un dispositif (72) d'étanchéité destiné à empêcher l'écoulement du fluide de refroidissement à l'extérieur des canaux (66, 68) entre les parties annulaires rotative (64) et fixe (62), un premier passage (80) de fluide formé dans la partie annulaire fixe (62) et ayant une première ouverture (84) dans l'alignement du premier canal (66) et un second passage (86) formé dans la partie annulaire fixe (62) et ayant une ouverture (90) dans l'alignement du second canal (68), les passages (80, 86) de la partie annulaire fixe étant raccordés au dispositif (110) de circulation de fluide, si bien que

le fluide de refroidissement circule dans le premier passage (80) vers le premier canal (66), circule du premier canal (66) vers le châssis rotatif (40), absorbe la chaleur du tube radiographique, circule du châssis rotatif (40) vers le second canal (68), et s'écoule dans le second passage (86) de la partie annulaire fixe (62).

13. Appareil selon la revendication 12, comprenant en outre un organe de refroidissement mécanique (D) monté à demeure en communication avec les passages (80, 86) de la partie annulaire fixe afin qu'il refroidisse le fluide de refroidissement.

14. Appareil selon la revendication 12 ou 13, dans lequel la partie annulaire rotative (64) comporte en outre une paire de canaux (74) de fuites disposés vers l'extérieur du premier et du second canal (66, 68) de fluide de refroidissement afin qu'ils reçoivent le fluide de refroidissement qui a fui par les dispositifs d'étanchéité (72), un dispositif (76) d'étanchéité aux fuites est placé à l'extérieur des canaux de fuites (74) afin qu'il retienne le fluide qui a fui dans les canaux de fuites (74), et un troisième passage (94) est délimité dans la partie annulaire fixe (62) et a des ouvertures (96, 98) dans l'alignement de chacun des canaux de fuites (74) afin qu'il évacue le fluide de refroidissement contenu dans ces canaux.

15. Appareil selon la revendication 11, dans lequel la bague collectrice fluidique (60) comporte une partie annulaire fixe (62) et une partie annulaire rotative (64), l'une (64) des parties annulaires fixe (62) et rotative (64) ayant une série de canaux (66, 68) formés dans cette partie, les canaux (66, 68) coopérant avec l'autre partie annulaire (62) pour la délimitation entre eux d'au moins deux canaux de circulation de fluide.

16. Appareil selon la revendication 15, comprenant en outre un premier joint annulaire (72) disposé entre les deux canaux (66, 68) et deux joints annulaires supplémentaires d'étanchéité (72) placés respectivement à l'extérieur des deux canaux (66, 68), afin que les joints d'étanchéité (72) empêchent la sortie du fluide des deux canaux (66, 68) et le mélange entre les deux canaux (66, 68).

17. Appareil selon la revendication 16, comprenant en outre des canaux annulaires (74) d'évacuation placés dans l'une au moins (64) des parties annulaires (62, 64) vers l'extérieur des premier et second canaux (66, 68) pour la réception du fluide de refroidissement qui a fui par les joints d'étanchéité (72), et un dispositif supplémentaire d'étanchéité (76) placé à l'extérieur des canaux d'évacuation (74).

18. Appareil selon la revendication 17, dans lequel la partie annulaire fixe (62) a une surface interne lisse qui coopère avec les joints annulaires (72) d'étanchéité et le dispositif (76) d'étanchéité.

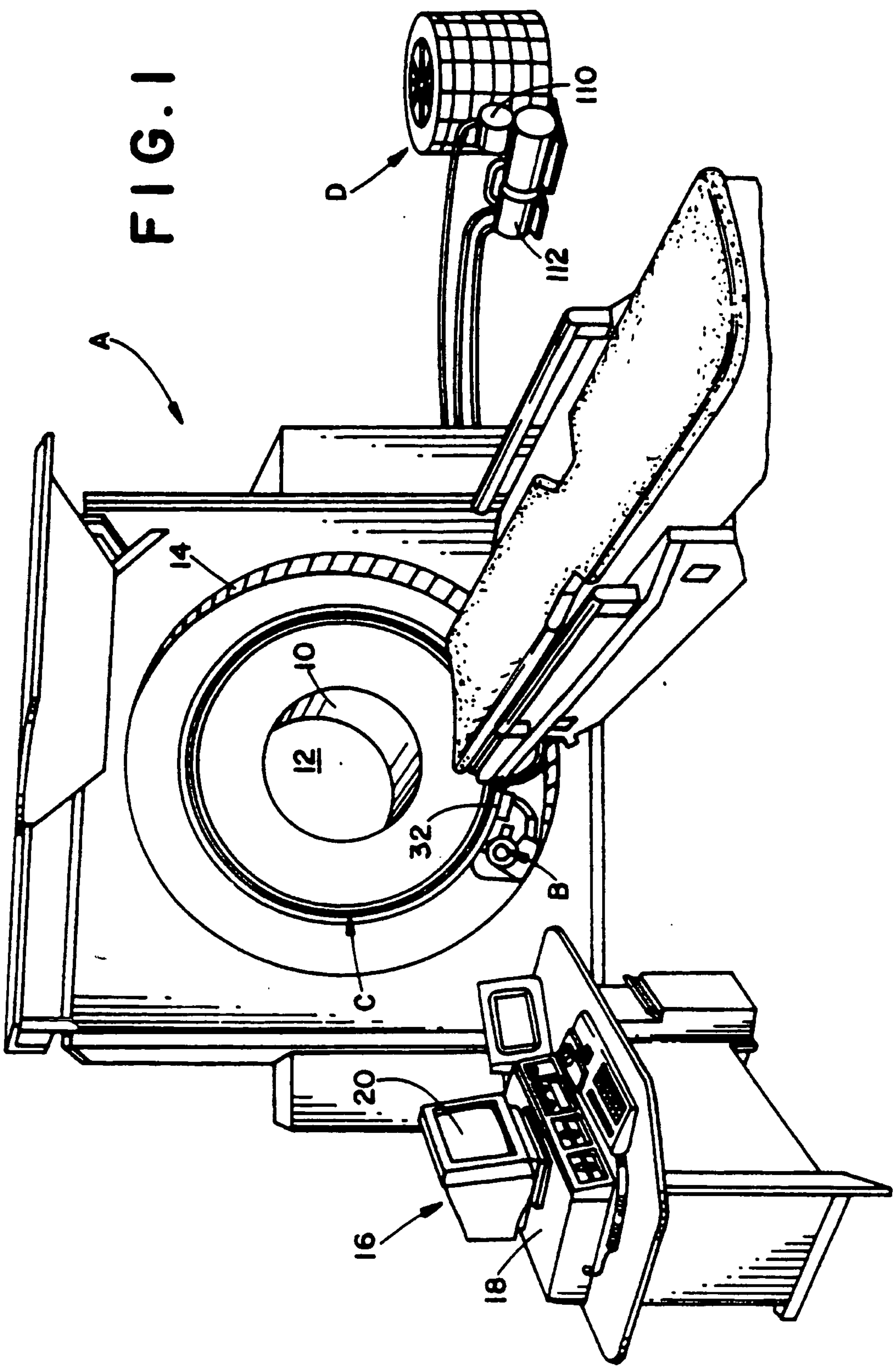

FIG. 1

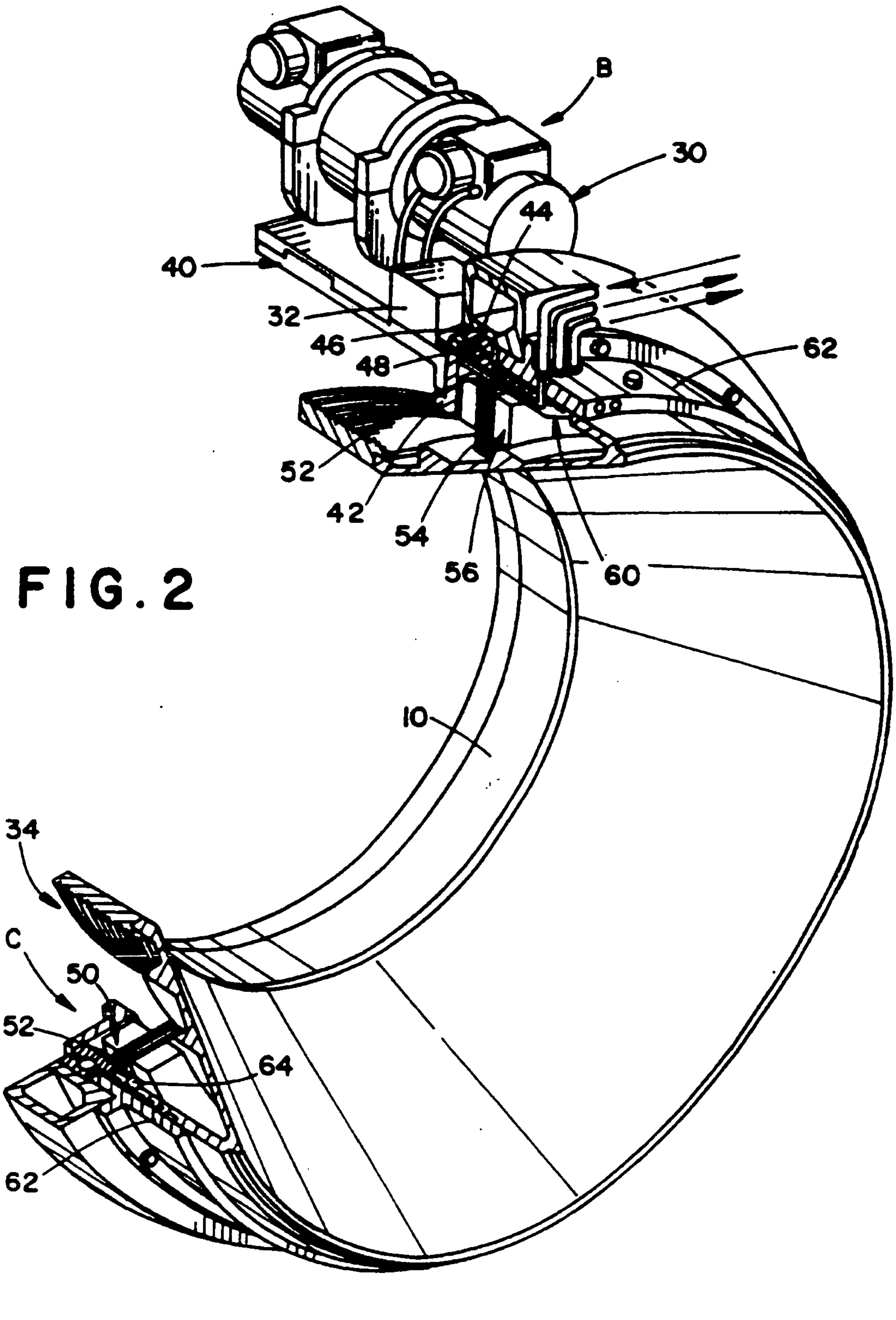

FIG. 2

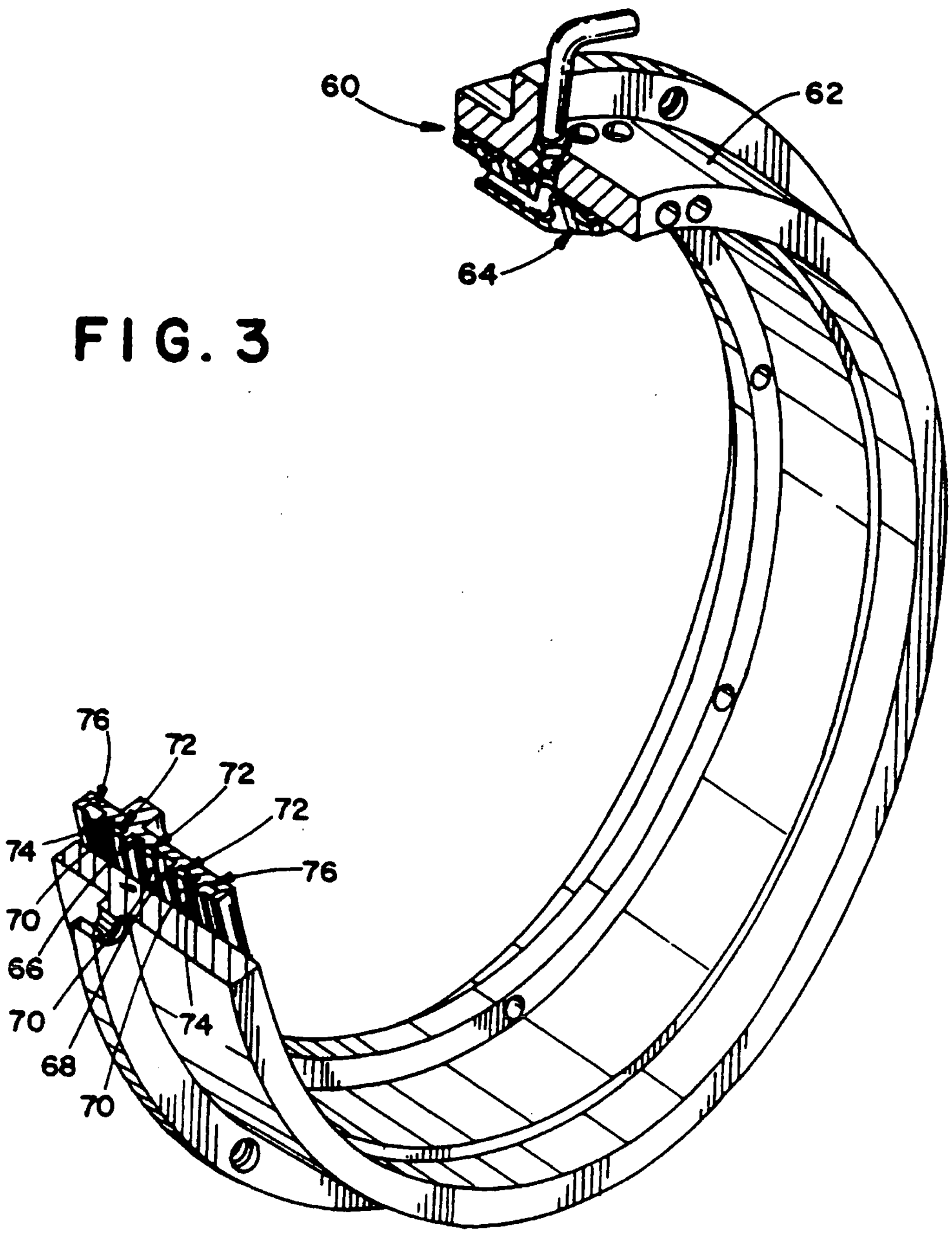

FIG. 3

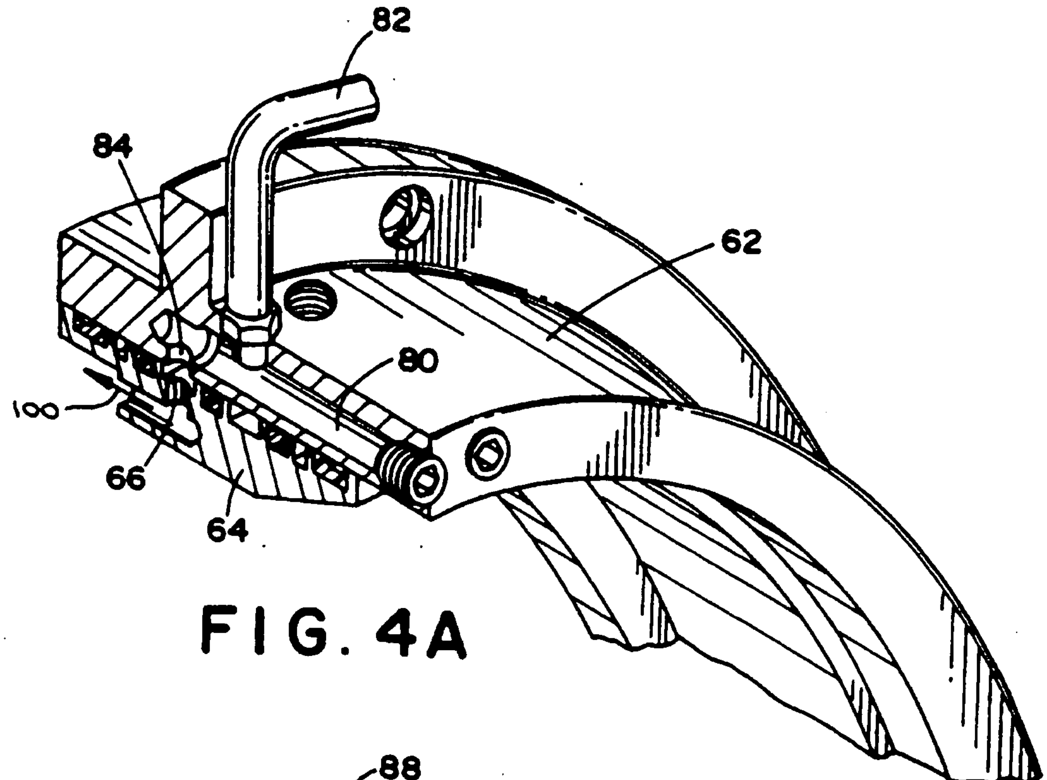

FIG. 4A

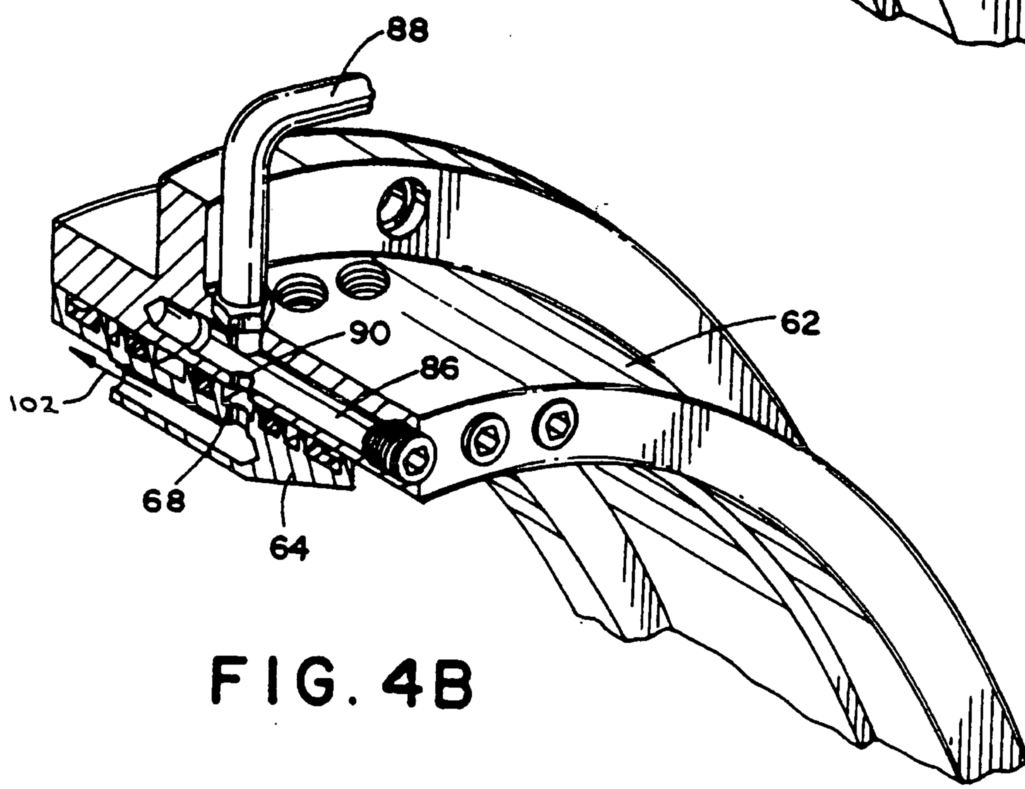

FIG. 4B

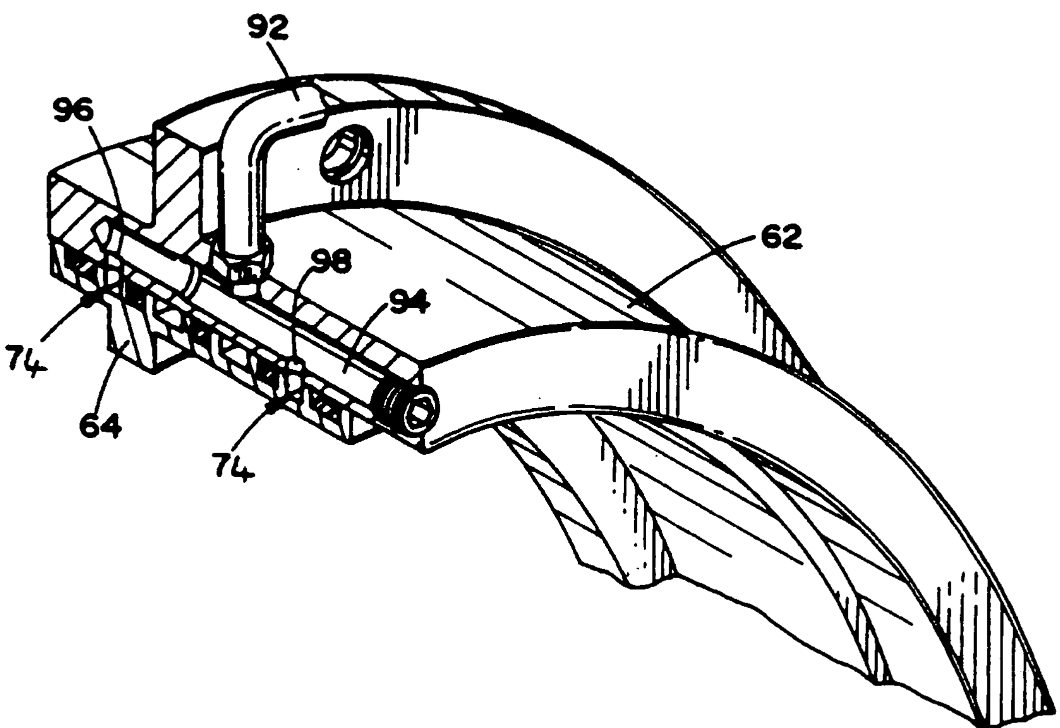

FIG. 4C